What is claimed is:

1. A polymeric positive temperature coefficient (PTC) device comprising:

a composite polymer having a conductive substance dispersed therein; and

at least one pair of electrodes electrically connected with the composite polymer,

the composite polymer having a particular crystalline structure formed by subjecting the composite polymer to cross-linking, heating the cross-linked polymer at a temperature approximately at or above a melting point of a polymer material, and re-crystallizing the heated polymer.

2. The device of claim 1, wherein a resistance of the composite polymer returns to its approximate original level after an overcurrent is applied thereto.

3. The device of claim 1, wherein the composite polymer has an initial resistance, and a subsequent resistance after receiving an overcurrent being approximately equal to the initial resistance, due to the particular crystalline structure of the polymer.

4. The device of claim 1, wherein the composite polymer comprises a polymer material, a conductive filler material, and at least one other additive.

5. The device of claim 4, wherein the polymer material is selected from

a group comprising polyethylene, co-polymer of polyethylene, polypropylene, ethyl/propylene co-polymer, polybutadiene, acrylate, acrylic ethylene co-polymer, and polyvinylidene fluoride, or any combination thereof.

6. The device of claim 4, wherein the conductive filler material is selected from a group comprising nickel powder, gold powder, copper powder, silver coated copper powder, metal alloy powder, carbon black, carbon powder, and graphite, or any combination thereof.

7. The device of claim 4, wherein the other additive includes a non-conductive filler material selected from a group comprising an anti-oxidizing agent, salt restrainer, stabilizer, anti-ozonizing agent, cross-linking agent, and dispersant, or any combination thereof.

8. The device of claim 1, wherein the polymeric PTC device is a polymeric PTC thermistor.

9. The device of claim 1, further comprising an insulator encapsulating the composite polymer while exposing a portion of the electrodes.

10. A polymer thermistor having a positive temperature coefficient of resistivity comprising:

a composite polymer having a conductive substance dispersed therein; and

at least one pair of electrodes electrically connected with the composite

polymer,

the composite polymer having a particular crystalline structure formed by cross-linking the composite polymer and heating the cross-linked composite polymer at a temperature approximately at or greater than a melting temperature of a polymer material to maximize a cross-linking rate of crystals therein, and by cooling the heated polymer for approximately no more than five minutes to minimize a size of the crystals.

11. A method of forming a polymeric positive temperature coefficient (PTC) device, the method comprising:

providing a composite polymer layer;

forming at least one pair of electrodes on an upper surface and a lower surface the polymer layer to obtain an intermediate structure;

dividing the intermediate structure into samples of a desired size;

subjecting the samples to cross-linking; and

re-crystallizing the samples to form a polymeric positive temperature coefficient (PTC) device.

12. The method of claim 11, further comprising a step of first heating processing the samples prior to cross-linking.

13. The method of claim 12, wherein the first heat processing comprises a step of heating at a temperature that is approximately between a melting point of the polymer layer to 100°C above the melting point of the polymer layer, and a step of relatively slow cooling at about room temperature.

14. The method of claim 11, further comprising a step of second heat processing the samples after cross-linking.

15. The method of claim 14, wherein the second heat processing comprises a step of heating at a temperature that is approximately between a melting point of the polymer to 100°C above the melting point of the polymer layer, and a step of relatively rapid cooling at a temperature that is approximately between room temperature to 0°C for no more than five minutes.

16. The method of claim 11, wherein the composite polymer layer comprises a polymer material, a conductive filler material, and at least one other additive.

17. The method of claim 11, wherein the cross-linking is achieved by irradiating the samples and/or performing chemical cross-linking.

18. The method of claim 17, wherein the irradiating is performed by an electron beam.

19. The method of claim 11, wherein the re-crystallizing is performed by cooling the samples to minimize a size of the crystals.

20. The method of claim 11, wherein the formed polymeric PTC device is a polymeric PTC thermistor.